I claim:

1. A microfluidic structure, comprising:

an electrostatic sealing device comprising:

a first electrode;

a second electrode opposite the first electrode, the second electrode capable of moving toward the first electrode and forming a seal with the first electrode in response to a voltage difference between the first electrode and the second electrode,

wherein at least one of the first electrode and the second electrode comprises a elastic layer facing the other electrode.

2. The microfluidic structure of claim 1, wherein each of the first electrode and the second electrode comprises a respective elastic layer.

3. The microfluidic structure of claim 1, wherein at least one of the first electrode and the second electrode comprises one or more layers comprising gold, silver, platinum, palladium, copper, aluminum or alloys thereof.

4. The microfluidic structure of claim 1, wherein at least one of the first electrode and the second electrode comprises indium tin oxide.

5. The microfluidic structure of claim 1, wherein at least one of the first electrode and the second electrode is a thin film electrode.

6. The microfluidic structure of claim 1, wherein at least one of the first electrode and the second electrode comprises an elastic conducting polymer.

7. The microfluidic structure of claim 1, wherein the elastic layer comprises one of more layers comprising rubber, thermoplastic rubber, silicone rubber, a fluoroelastomer, acrylic, cyclic olefin copolymer (COC), a urethane, polymethylmethacrylate (PMMA), polycarbonate, polytetrafluoroethylene, polyvinylchloride (PVC), polydimethylsiloxane (PDMS), a polysulfone, a siloxane, or a polyamide.

8. The microfluidic structure of claim 1, wherein:

the microfluidic structure additionally comprises:

a first component comprising the first electrode, and

a second component comprising the second electrode; and

the seal is formed between the first electrode and the second electrode when the second component is aligned relative to the first component such that the second electrode proximate to the first electrode and the voltage is applied between the electrodes, the seal detachably interconnecting the first component and the second component.

9. The microfluidic structure of claim 1, wherein:

the microfluidic structure additionally comprises:

a substrate, and

a microchannel defined in the substrate;

the first electrode comprises an elastic membrane covering a lengthwise portion of the microchannel; and

the second electrode is located in the microchannel opposite the first electrode.

10. The microfluidic structure of claim 9, wherein each of the first electrode and the second electrode comprises a respective elastic layer.

11. The microfluidic structure of claim 9, wherein at least one of the first electrode and the second electrode comprises an elastic conducting polymer.

12. The microfluidic structure of claim 9, wherein at least one of the first electrode and the second electrode comprises indium tin oxide.

13. The microfluidic structure of claim 9, wherein the elastic layer comprises one or more layers each comprising rubber, thermoplastic rubber, silicone rubber, a fluoroelastomer, acrylic, cyclic olefin copolymer (COC), a urethane, polymethylmethacrylate (PMMA), polycarbonate, polytetrafluoroethylene, polyvinylchloride (PVC), polydimethylsiloxane (PDMS), a polysulfone, a siloxane, or a polyamide.

14. The microfluidic structure of claim 9, additionally comprising a layer of rigid material over the elastic membrane.

15. The microfluidic structure of claim 9, wherein:

at least one of the electrodes comprises electrode segments disposed along the length of the microchannel; and

the microfluidic structure additionally comprises a circuit operable to apply voltage to the electrode segments independently.

16. The microfluidic structure of claim 15, wherein the circuit is operable to apply the voltage to the electrode segments sequentially along the length of the microchannel.

17. The microfluidic structure of claim 15, wherein both electrodes comprise electrode segments disposed in pairs along the length of the microchannel.

18. A method for pumping fluid through a microchannel in a microfluidic structure, the method comprising:

providing the microfluidic structure of claim 15;

establishing voltage differences between the electrode segments and the other electrode in a sequence progressing along the length of the microchannel such that electrostatic seals sequentially formed between the electrode segments and the other electrode displace the fluid in a desired direction.

19. A method for electrostatically forming a seal in a microchannel in a microfluidic structure, the method comprising:

providing the microfluidic structure of claim 9; and

applying a voltage difference between the first electrode and the second electrode to form the seal between the electrodes and block the microchannel.

20. A method for detachably connecting two components of a microfluidic structure, the method comprising:

providing a first component comprising a first electrode;

providing a second component comprising a second electrode;

disposing the first component opposite the second component with the electrodes opposed; and

applying a voltage difference between the first electrode and the second electrode to form a seal between the electrodes.